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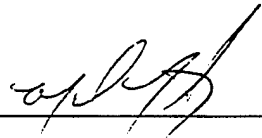
WALL STREET AND NETWORK-CENTRIC WARFARE: THE HUMAN-CENTRIC
APPROACH TO CONCEPT APPLICATION

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Abstract

WALL STREET AND NETWORK-CENTRIC WARFARE: THE HUMAN-CENTRIC APPROACH TO CONCEPT APPLICATION

The Network-Centric Warfare concept has extensively used civilian sector models during development. As the transition from concept to application occurs, these civilian sector models should be further utilized for insights into network-centric operation. Stock market investment companies maintain the human-centric approach to their network-centric operations.

The focus of investment companies in technology, organization, and intelligence is with the human user in mind. Artificial intelligence, display capabilities, and training integrate technology with the human user. Unit organization and an operational pause capability maintain the human-centric orientation. Companies have placed a renewed emphasis on intelligence as recent regulations provide for a transparency of information.

The end result is an information intensive organization that functions at a high operational tempo. By observing network-centric operations of investment companies, the gap between Network-Centric Warfare concept and application can be bridged.

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Introduction

As the concept of Network-Centric Warfare - leveraging technology and information for massing effects - matures, several schools of thought are developing. These range from the extremes of technology focused, where technology is the most important aspect, to technology critical, where it is believed that technology will lead to information overload. Additionally, others are concerned that Network-Centric Warfare (NCW) is a method of "warfare on the cheap", wherein smaller forces can operate more efficiently. The conflict between these groups has the potential to lead the NCW concept astray.

To maintain the focus of NCW during the transition from concept to application, civilian sector models may help. Financial investing is one area that provides real-world lessons learned for application to NCW. The stock market continues to show how NCW principles can be applied. Specifically, investment companies have balanced technological developments with human capability for improvements in efficiency. More importantly, investment companies maintain a human-centric approach to network-centric operations. By analyzing developments in information dissemination and processing within investment companies and applying them to warfare, the NCW concept can remain grounded during development.

During the NCW concept development, many civilian sector models have been examined to demonstrate the capabilities of technology and applications of network-centric principles. The precision manufacturing of Dell Computer Corporation, focused logistics of Federal Express, precision retailing of Walmart were analyzed. Additionally, the New York Stock Exchange is used as an example of NCW dynamics. These examples demonstrate the importance of information to these organizations and provided insights into information dissemination, organizations, and time compression. These network-centric "hall of fame"

companies show what is achievable through robust networking strategies. This is important in concept development and gaining grass roots support for NCW. However, as the NCW concept matures and becomes reality, these existing models must be further mined to bridge the gap from concept to application.

Network-Centric Warfare and the Stock Market

The stock market can be examined at various levels to obtain insights into NCW. The organizational relationships and the dynamics of information flow and decision-making that occurs on the floor of the New York Stock Exchange contain parallels to the NCW concept.¹ Although useful for concept development, much of the information is stovepiped and the decision makers function as a bistable, an on (yes) or off (no) decision.² A NCW organization will not have the luxury of limiting focus to small information sets and similarly small decision possibilities. A more useful look at the investment industry for NCW principles is found in the investment company operations. These companies, like Bear Stearns or Morgan Stanley Dean Witter, have numerous functional groups with different missions and therefore different demands for information. This requires that these companies to construct a robust information dissemination capability. The best analysis is made by looking at investment companies' information dissemination and use in a real-time or near real-time environment. Prior to exploring this, the similarities of investment companies' operation and NCW principles must first be shown.

Some of the key components of NCW are information superiority, shared awareness, adaptability, speed of command, and self-synchronization.³ The stock market utilizes these five aspects in its daily operation:

- 1. Information Superiority.* Investment firms strive to achieve information superiority. By tapping into the vast sources of information, traders and analysts attempt to

know all the information about a particular company in order to make investment decisions. Information in the stock market today is nearly transparent, i.e. shared by all. One assumption of NCW is the ability to obtain information superiority. Although a reasonable assumption today given the likely opponents of the United States, twenty years from now against a technologically adept opponent, this assumption may break down. In this "transparent battlefield", the ability to act first and effectively on this information is vital. By considering investment companies' adaptation to these transparencies, future NCW implications can be derived as the battlefield becomes transparent for both sides.

2. *Shared Awareness.* Shared awareness is prevalent in investment companies. Every person in a company has the capability to obtain information concerning a particular equity at any time. The trader in a mutual fund has the same information as an analyst who has the same information as the fund's manager or even the president of the company. How these companies operate in this environment can provide insight into how the military will operate when the National Command Authority has the same operational picture as the warfighter.

3. *Adaptability.* To the uninformed, the stock market may not appear adaptable. Upon a superficial review, the market appears the same as when it was first formed. Technology has only changed the way accounting is performed but the same fundamental trading principles apply. In reality, the market is constantly changing. The recent technology revolution has led to numerous on-line investment companies and an explosion of individual investors.⁴ The large investment companies have had to adapt to keep their competitive advantage. Additionally, the Securities and Exchange Commission (SEC) is constantly changing the fundamental rules of the market place requiring further adaptation by investors.

4. *Speed of Command.* Speed of command is the process of turning a superior information position into a competitive advantage.⁵ Technological changes have resulted in investment companies evolving into organizations that improve the speed of command. In a transparent battlefield, the only domain that is left is the time domain. The ability to act correctly and faster than your opponent will be the difference in success or failure.

5. *Self-Synchronization.* To obtain the competitive advantage, many mutual fund organizations have evolved into a self-synchronized body. The ability of the individual traders to act rapidly is crucial to take advantage of changes in a rapidly moving market. Fund managers have empowered trading teams to take action unilaterally in order to survive. These guidelines are similar to military doctrine and the commander's intent.

In principle, the stock market functions daily within the bounds of the NCW concept. The existing technological and organizational structures of investment companies can be examined to assist the transition from the NCW concept to operations. Although useful for providing insight to the application of NCW, the investment company model is not a perfect fit for the military's NCW concept. Understanding the differences can be as important as the similarities.

Stock Market Differences

The investment company model is not a direct parallel for war fighting at several levels including risk aversion, connectivity, and an undefined enemy. Investment companies naturally have aversion to risk (financial loss). Robert Hackney, Fund Manager at Arnhold and S. Bleichroeder Incorporated (ASB inc.) states, "Conservation of capital is the key to survival in the market."⁶ Typically, in the market, the investor that

takes risk does not survive. War fighting has similar aversion to loss but there is an appropriate time to take risk.

The information and connectivity required by the market is not as agile as required by the military. Most connections are via land lines and are very reliable. The military requirements of wireless connectivity provides an added dimension of difficulty for technology and an added vulnerability to attack that is not present in the market.

Finally, the nature of the enemy is significantly different. There is no real enemy in the market. Analysts basically perform "intelligence estimates" on companies expected revenues and expenditures and provide information to the traders. The companies are not trying to deny this information to analysts nor are they attempting to mask their operations through deception. Another view is that the other investment firms or private investors are the enemy. This is essentially true, but other investors do not try to prevent action of a company. The only "enemy action" is to move into or out of positions in a stock prior to other investors. In practice, many investment companies actually share information;⁷ therefore there is no defined "enemy" in the military sense.

Although the stock market model does not provide a direct parallel for NCW, the information dissemination and utilization methods can be used as a framework for future NCW operations. Investment companies do not strive to win wars but to make money. This desire is precisely why the market model is important and useful. These companies do not survive without being successful. Their network-centric operation is tested daily. By undergoing many Darwinian-like evolutionary cycles, the surviving companies are the ones that have best adapted to technology improvements.⁸ This is unlike the military that may undergo changes that are not tested in battle for years, save through wargame

modeling and exercises. Meanwhile, investment companies have been "battle tested" and proven. With a thorough understanding of both how this model is similar and differs from NCW, the operations within the investment company model can be effectively "lifted" and applied to NCW.

Investment Company Model

The insights the investment company model provides can be seen by analyzing how information dissemination relates to three main areas: technology infrastructure, organization of the companies, and the reliance of these companies on intelligence. These three areas have evolved with the continued emphasis being placed on the end-user. This human-centric approach is vital to the success of investment companies.⁹ This fact should not be lost as the military transitions from NCW concept to operation.

Human-Centric Technology Infrastructure

Investment companies have developed and continue to improve their technology infrastructure to better serve their employees. Investment companies have diverse organizational groups. These groups range from investment banking, to retail investing (individual customers), mutual funds, institutional trading (investing the company's money), treasuries and bonds, derivatives (options, futures), etc. The information required for traders and analysts to be successful in their job is massive. Many news services exist (Bloomberg, Reuters, Dow Jones News Wire) that provide news to computers. Television news sources including CNBC, CNNfn, and Bloomberg) are monitored. Real-time prices for a multitude of equities, derivatives, and bonds are essential because they have interrelated effects. Even Internet financial chat rooms are monitored for the occasional

rumor. The recent addition of Regulation FDⁱ has also increased the amount of news released from companies. For example, a Chief Executive Officer reveals new information concerning his company's performance (intentionally or unintentionally) during a speech to a small group of individuals, this information must be revealed to the general public within a short time interval. This new requirement has caused a surge in the number of press releases from companies and web cast events.¹⁰ The end result is that there is a huge amount of information that could be useful to traders. Attempting to digest this information to make decisions is demanding.

Although some studies have argued that information overload is not an issue¹¹, these studies are limited to highly specialized groups of traders with stovepiped information and bistable decision making as discussed earlier. The investment firm trader can be overwhelmed by the available information.ⁱⁱ Disseminating massive amounts of incoming information is a daunting task, and doing so without causing decision paralysis in the trader can be even more formidable. Not only must the information be provided to the users, but also it must be displayed in a useable manner.

Artificial Intelligence

To meet these challenges, many companies are beginning to look at artificial intelligence (AI) for information dissemination. This area has undergone a recent revival. Originally, AI was focused on replacing human decision makers with expert systems. Now there is emphasis towards using mainstream computing systems that create strategic

ⁱ Regulation FD (Fair Disclosure) is a SEC regulation that took effect October 23, 2000. Regulation FD prohibits companies that are traded on the stock market from providing information to investment companies prior to making it known to the general public. By prohibiting this unfair disclosure, the SEC has provided for a transparent market.

ⁱⁱ This is the author's conclusion based upon several discussions with investment firm traders at Arnhold and S. Bleichroeder, Inc. and Bear Stearns.

advantage through information mining.¹² More powerful than systems that search for key words, AI system development is focused on distilling information needs, finding information, and displaying this needed information in a useful way.¹³ Donald Henderson, Managing Director Information Technology at Bear Stearns states "Traders want all the information available concerning their sector. AI can effectively distill this information in a real-time environment and will be used in this industry."¹⁴

One such product being examined is from a company named VCM Vertical. Their, soon-to-be-launched, website called VCM Financial is devoted to providing individual investors with information presented real-time in a usable format. VCM Financial's algorithms "reads" tens of thousands of news stories and determine the stories' content. This content is distilled and sorted according to a variety of categories. Additionally, the program monitors postings on numerous Internet financial chat boards and determines real-time investor mood based on the content of the postings.¹⁵ The end result is a presentation of information in a user-friendly environment. The trader/analyst gets the stories concerning only companies or sectors of concern and organized by subject matter. This is a significant first step in managing information with AI. Artificial intelligence offers significant capabilities with respect to information dissemination.

Artificial intelligence does not eliminate humans in the decision-making process. It mines and presents the information in a useable format. Humans format the rule sets provided to the AI program to ensure the correct information is presented. Again, the focus is not on the technology, but how the technology can improve the human's effectiveness. Investment companies, much like the military, have many diverse groups relying on massive quantities of information. The use of AI can effectively tailor the information that is

provided to the end-user in a NCW environment. The infantryman, fighter pilot, submariner, joint task force commander will need different levels of information to be successful. By using AI, rule sets can tailor this information to the specific end-user. By providing each user the appropriate real-time information, in a needs-based display, the massive amount of information available in a NCW environment can be presented without causing information paralysis to the human user. This technology has NCW applications and should be investigated for military use.

Adaptable Information Display

The desks of most traders have four computer monitors displaying information. Additionally, there is a phone bank used to contact floor brokers or other companies. This phone bank is programmable that allowing each trader to program each button with a different company that also displays the company name. All traders utilize the same news services provided, but each trader has the monitors set up to display information differently based on personal preferences. Donald Henderson, Managing Director of Information Technology at Bear Stearns states, "The goal of the information technology department is to provide the trader with the ability to do their job. By allowing the traders the ability to display information based on their preferences, they can function more effectively."¹⁶ Each trader has the capability to manipulate the display of information on their "virtual workspace" based on their use of the information and their own methods for digesting the information.

The fundamental philosophy in the investment companies is that the traders/analysts are responsible for their performance, and are held to those standards. They are not told what information is to be displayed nor are they told how the information

is to be presented on their work screen. The ability to conform displays to the user's preference is another method of improving efficiency of the traders. Typically, military systems have not allowed this type of flexibility. Moreover, tactical publications are stringent and normally prescribe the format of displays limiting the freedom of the operator. NCW organizations should design adaptable displays to allow the human user improved efficiencies.

Display Capabilities and the Human

As investment companies transitioned with emerging technology, they were able to display a large amount of information on relatively few screens. For example, traders several years ago utilized thirty-two green screen terminals to display the same amount of information that is displayed on only two color monitors today.¹⁷ By using flashing, shading, and colors, information displays are compressed but without losing data. During this transition, one trader refused to change to the color displays. Although he could not effectively monitor all of the terminals, he relied on visual cueing to alert him to a change in market conditions. In essence, this trader "wrapped" himself with monitors in order to "feel" the market.¹⁸ Again, the end-user needs to be the focus. This example illustrates the requirements for a person to understand the system's operations as well as have a level of experience prior to employment. Without detailed training and experience, these traders could be forced into an active market without the ability to use the new technology to their advantage. Investment companies rely heavily on training and familiarization with the technology prior to use. The focus is not on technology, but the human end-user. This lesson applies to the application of the NCW concept.

Unlike investment companies, the military cannot put a person in front of the same display over a twenty-year career. Additionally, space effects the display capabilities; an infantryman does not have the same display capability as a tank commander or an aircraft carrier Combat Information Center. To overcome this hurdle, military systems should be similar between services in display methodology and input/output interface capability. Similarly, the United States should undertake a program for consistencies amongst our allies. This will be vital in a continued combined environment with ad hoc joint task forces and coalition operations. Although this will not be easily accomplished given the current stovepiped acquisition structure, it is vital if NCW is to evolve. Without focusing on the human user, the gains offered by technology could be negated. During application of the NCW concept, the human-centric approach is vital to success.

Human-Centric Organization

Investment companies normally utilize small teams of individuals for mutual fund management. Most of the teams consist of several traders, several analysts, and a manager (who may have either been a trader or analyst). Traders are responsible for placing orders to buy or sell a particular stock either through a broker or through an electronic exchange. Analysts are responsible for doing the research and estimating what a company will earn and how it should grow. The fund managers are responsible for overall direction of the fund. The traders and analysts work for the fund manager trading within given guidance. It is useful to examine the operations of these groups for insights into NCW organization.

Risk Arbitrage

The merger and acquisition risk arbitrage fund at Arnhold and S. Bleichroeder, Inc. (ASB Inc.) relies on self-synchronization principles for daily operation. Traders and

analysts sit at adjoining desks in coordination of this fund.ⁱⁱⁱ The fund may hold thirty or more companies in their portfolio. As news breaks during the day, the traders have to act rapidly to ensure that they are positioned to either take advantage of good news or cut risk if the news is negative. Every person in the fund (traders or analysts) is empowered to order a sale (or purchase) of a position in a company based on their confidence in the news. If the ramifications of the news story are not clear cut, then the traders and analysts quickly discuss the story and decide on an action. The fall back position is to take action to limit risk.¹⁹ The actions taken by the traders and analysts are limited not to exceed a risk of a small percentage of the fund without approval of the fund manager. The collaboration of analysts and traders in a real-time information environment takes advantage of their unique insights during the decision-making process. In a rapidly changing NCW scenario, intelligence specialists may be similarly used in a command center to aid the warfighter. A real-time intelligence capability is a must for NCW operations. Not only should the warfighter act upon the information but also the intelligence specialist's insights will result in a better decision-making process. Thus the tempo and responsiveness of the organization can be increased along with improved quality of the decisions made.

The traders and analysts who actually run the tactical operations of the fund are guided by their own "doctrine" much like the NCW rule sets. Doctrinally, the traders are limited to a certain risk percentage without higher approval and are given the fundamental guidance to limit risk.²⁰ The fund managers have a daily meeting with the traders and analysts during which they decide how they will change their stock positions. The traders

ⁱⁱⁱ The practice of analysts and traders working side-by-side is not consistent within the industry. Some larger companies segregate analysts and traders. Additionally, companies have some analysts separated and some intermixed.

then buy and sell stock based upon this guidance. The fund manager gets updates during the day concerning the progress or any significant problems accomplishing this "mission." By applying rule sets to fund management, investment companies have increased the tempo of their operation while maintaining their organizational focus.

Operational Pause

The stock market has increased in volatility due to the increased speed of network-centric operations and uncertainty with Regulation FD.²¹ The speed of information and action has increased to a rate that the stock market relies on operational pause to limit the effects of the network-centric operations. Regulation FD has caused increased uncertainty-associated volatility in the market. Prior to Regulation FD, if a company's stock price was observed for the weeks preceding an unexpected report of earnings it would reflect a change in which the stock slowly rose in value if there was good news or just the opposite for bad news. This was because the large institutional investors were warned prior to the news release. Upon release of the information there would be a prompt jump of price in the direction of the news due to the uninformed investors making trades based on the release of news. After Regulation FD, without the companies pre-warning the analysts, the prompt jump of the stock price upon news release is more severe. This is because the institutional investors are now rapidly buying or selling the stock when the news is released rather than during the days prior to the release. Time compression through the use of technology and high tempo organizations has resulted in greater volatility.

The market combats extreme volatility by "halting" trading in a stock when a large imbalance of buy or sell orders exists. Additionally, the market in general, limits trading (curbs) in certain issues on large up or down days and will momentarily stop trading

(circuit breakers) on extremely volatile down days.²² This increased volatility due to a “transparent” market has implications for a NCW battlefield. The speed of operation through the network can cause rapid and large firing effects that may not be desired. For example, a controlling node may direct several targets to engage an enemy position simultaneously. The speed of decisions within a NCW environment may again direct engagement prior to full evaluation of the success of the first attack. Likewise, the sensors may detect fragments of the enemy's position as valid targets and call in additional fires. This results in a significant depletion in resources due to a increased speed of operations. As we strive to compress time and mass effects through network-centric operations, there comes a point where the tempo is too high. The stock market has experienced this and NCW operators will likely see the same effect. A similar capability as the trading curbs or circuit breakers in the stock market for operational pause may be necessary in a NCW system if the speed of operation overwhelms the human organization and is detrimental to the mission. Maintaining a human-centric focus - understanding the capabilities as well as the limitations of the human operators - while applying the NCW concept is vital.

Human-Centric Intelligence

Historically, investment companies have relied heavily on analysts. These “intelligence specialists” research a company’s production, research and development programs, marketing, sales, and even the personality of key management personnel. This information, coupled with economic conditions, provides an estimate of future performance. Analysts also digest real-time news from the company including conference calls, earnings release, and company meetings to determine how the company is performing. Based on the compilation of this data, the analyst then recommends a buy,

hold, or sell stock in the company. Investment companies' use of analysts provides us with insight on intelligence within NCW organizations.

Regulation FD

Regulation FD has sent shockwaves through the financial markets. The primary effect is that analysts have to get back to the basics of research.²³ Now, more than ever, analysts' work is crucial for a company to be correctly positioned in the markets. The analyst that has not accurately predicted the performance of a company may place a fund at significant risk when earnings are released. This effect, which caused investment companies to provide a renewed emphasis on intelligence because of information transparency, is another lesson that should not be lost during the NCW concept application.

As sensor technology proliferates and our enemies can also see the entire battlefield, commanders will rely more heavily on the intelligence community. This is because sensors provide only data; intelligence operators predict the intentions of the enemy based on the data. The intentions of the enemy will become invaluable once the enemy can mirror our information collection capability. Investment companies, in response to Regulation FD, have placed the emphasis on analysts vice compressing the traders' ability to act. It seems that the largest dividends are gained by placing the focus on analysts. The speed a trader can react to information has reached a plateau. Small gains could be made by trying to compress the trader's reaction time even further, but much larger gains are obtained by improving the quality of the product from the analysts.²⁴ As NCW concept becomes a reality, the warfighter's reaction time will be compressed to a finite level. The overall effectiveness of the military in battle would be improved if the warfighter were adequately armed with the knowledge of the enemy's intentions. Accurately predicting the enemy's

intentions and being able to perform a running analysis on these intentions during operations will become very important in a NCW environment. Human intelligence sources and intelligence analysts evaluating information collected can only achieve this type of intelligence. The value of the human in the intelligence network will increase during the transition to NCW and a transparent information environment.

Analyst Meetings

Large investment companies have offices world wide but the analysts tend to be located at the New York City offices. Bear Stearns, an investment company, conducts a daily conference at which analysts brief particular sectors of the stock market. Each meeting is broadcast live via a video-teleconference link and digitally recorded and archived on their network. Previously, transcripts of these meeting were faxed to the worldwide offices. Now, if the live web cast of the conference was missed, a person in a Bear Stearns office overseas can view the meeting on their computer. Additional search tools allow the individual to eliminate portions of the conference in which they are not interested. "The utility of this capability is that now traders and similarly interested individuals do not have to read through large transcripts to obtain the information they need. Our dissemination of the conferences is more efficient. Also, the user of the information now sees body posture, hears voice inflection, and many other subtle ways to get a feel for the confidence of the analyst on the subject..."²⁵ states Lance Bondy, Vice President of E-Commerce, Bear Stearns. This information dissemination capability has military application. Today, many intelligence briefing slides are available on the SIPERnet. Dissemination of the information in a video format is possible. This could simultaneously provide a better shared awareness of intelligence information at all levels

and have the added benefit of limiting the duplication of effort between echelons.

Intelligence and the dissemination of intelligence will continue to play a vital role as the transition to NCW is made.

Conclusion

The examples of many existing network-centric organizations that exist in the civilian sector can be used in the transformation of NCW from concept to reality. Investment firms' use of technology and their organizational structure can provide lessons for application to NCW. Although the stock market model is not the only possible civilian sector model exhibiting network-centric principles, the magnitude of information processed, the speed that decisions are reached, and the impact wrong decisions have on the survival of the company make this model well suited to draw parallels for NCW. The daily testing of this organization has provided for many evolutionary cycles for process improvement. The result is a well-tested and very effective organization.

In developing the NCW organizations, the primary focus, much like it is in the stock market, should be on the human user. From the warfighter to the operational and strategic commanders, the ability to be provide with real-time information in an efficient manner is crucial in an information-rich and rapid decision making environment. NCW developers should provide the warfighter systems with large, configurable displays that utilize artificial intelligence for information mining. Just providing the systems is not enough; massive efforts should be made for the education of the users in the operation and capabilities of the system. Additionally, acquisition barriers will need to be broken down to provide uniform technology between the services and allies. Most importantly, NCW operators should gain experience *prior to* real-world employment. Systems should not be

fielded without detailed testing and doctrinal guidance. Once fielded, demanding and realistic exercises should be frequently conducted to familiarize the warfighter with the equipment.

The stock market's reliance on intelligence in network-centric operation will be paralleled in NCW. The ability to disseminate intelligence can improve efficiencies and decrease duplication of efforts. The integration of intelligence specialists and warfighters in a real-time information environment should be evaluated. Additionally, much as investment firms were required to place a higher premium on intelligence estimates after Regulation FD provided for a transparent marketplace, a similar effect will take place in NCW as sensor technology proliferates and the battlefield becomes transparent to both sides.

The additional volatility associated with the passing of Regulation FD should be a warning to NCW commanders. The speed of decision in the stock market that causes wild fluctuations due to breaking news can have the same effect in NCW. The ability to provide "halts" for an operational pause should be designed into NCW systems much like the stock market has established trading curbs and circuit breakers.

NCW is not about technology. NCW is about rapidly bringing information to people by leveraging technology. The emphasis must be on the people in the organization much as it has been through history. If technology and capabilities are placed before the person operating the equipment, NCW concept will be doomed from the start. Observing human-centric operations in the network-centric environment of investment firms and effectively applying them can keep the process grounded and can effectively bridge the gap from concept to reality.

NOTES

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